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Title: High-Speed Wireless, Digital Internet Access

Summary: Visual Communications Network is launching what it says is the world's first wireless multimedia, digital network capable of delivering full-motion video. Operating at more than 180 times the speed of an integrated services digital network (ISDN) line, the company's high bandwidth network offers videoconferencing, data storage and retrieval systems, and Internet access to commercial customers.

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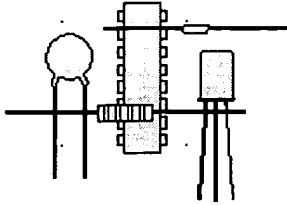
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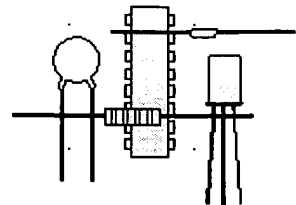


Technology CyberTrends

Professor John M. McCann
Fuqua School of Business
Duke University

Additions to this document since November 6, 1997

are preceded with the  icon.



This document contains a list of trends I have identified based upon quotes from managers, professionals, consultants, journalists, futurists, and educators who study the technologies that are driving the digital revolution, digital dawn, information highway, Internet, etc. Click on a topic to jump to the corresponding section of the document.

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Microprocessors: Driver of the Digital Dawn

- "The sand comes in the form of the silicon sliver the size of your thumbnail inscribed with a logical pattern as complex as a street map of America, switching its traffic in trillions a second. And that technology is going to move to a billion transistor chip in the next five or six years. A billion transistor chip -- equivalent to the processing power of 16 Cray YAMP supercomputers, or 42 telephone companies' central office switches that would cost some \$300 million -- is manufacturable on a single chip for less than \$100. This technology is just six or seven years away."
Source: George Gilder, "The Shattering of the Cable T.V. Monopoly," American Civilization, February 1995
- "Of course, most technical advances lead to only minor improvements in products and slight changes in the organization of work. ... But, in rare cases, an especially potent new technology will trigger a restructuring that ripples throughout the entire economy -- from the lowliest work cells to the largest organizations. Today, as the twentieth century draws to a close, we are in the midst of precisely this kind of massive structural transformation. Because we lack the benefit of hindsight, we cannot fully appreciate the magnitude of the economic restructuring we are now experiencing. But our descendants will almost certainly judge the 'computer-on-a-chip' to be the most economically significant technical achievement of the previous 500 years. The microprocessor ranks at the very pinnacle of human invention -- like the printing press -- it slashed the cost of encoding, copying, and communicating information. And by doing so, it has brought vast areas of previously unattainable knowledge within human grasp and has made possible a staggering array of new products. Today these products are profoundly altering the capabilities of millions of work cells in every niche of the global economy."
Source: Michael Rothschild (President of The Bionomics Institute), *Bionomics: The Inevitability of Capitalism*, Henry Holt and Company, 1990, p. 99
- "Born 25 years ago, the microchip has conquered the world. Today it's smarter and faster than ever -- and more dangerous. Fail to learn its ways and you'll be out of luck damn quick."
Source: Cover of *Forbes ASAP*, February 26, 1996
- "Alexander the Great conquered the known world in his mid-20s. The microprocessor, now 25, has done more, creating a world without limits. ... Since the introduction of the 8080, the microprocessor has embarked on a steady march through generation after generation of improvements, in the process pulling along all electronics, but especially the personal computer, in its wake. The modern Pentium or PowerPC is 1,000 times as powerful as the 8080 and contains three million transistors. This relentless progress, out-stripping any comparable technological advance, was first described by Intel's cofounder, Gordon Moore. Moore's Law, celebrated as the defining rule of the modern world, states that the computer chip performance doubles every 18 months. ... 'Moore's Law is important because it is the only stable ruler we have today,' says Tim Bjarin, president of San Jose-based industry watcher Creative Strategies. 'It's a sort of technological barometer. It very clearly tells you that if you take the information processing power you have today and multiply by two, that will be what your competition will be doing 18 months from now. And that is where you too will have to be.' ... Whatever form the chip takes, it will continue its phenomenal trajectory well into the lives of our grandchildren."
Source: Michael S. Malone, "Chips Triumphant," *Forbes ASAP*, February 26, 1996, pp. 53-82
- "As Craig Barrett, executive vice president and chief operating officer, explained, Intel continues to adhere to Moore's Law, which states that the number of transistors per chip doubles every 18 months. The company predicts that silicon scaling will reach its physical limit by the year 2017."
Source: Cade Metz, "Intel Pushes Pentium Pro," *PC Magazine*, August 1996, p. 36
- "All computing is built atop an underpinning of semiconductor-based integrated circuits, which has the remarkable property of dramatically increasing its price/performance far faster than

anything else in the history of our economy. In the 1970s, the rate was already an astounding order of magnitude every ten years. In the 1980s it decreased to an order of magnitude every seven years. In the middle of the 1990s the time has compressed to three and a half years. By the end of the decade microprocessor-based systems will increase ten times in power every 2.5 years. And there is no foreseeable end in sight."

Source: Geoffrey A. Moore, *Inside the Tornado*, Harper Business, 1995, p.6

- "The microprocessor is the most important invention of the twentieth century. ... The microprocessor constructs its own society; in the emptiness of its millions of transistors awaiting instruction lies a near-infinity of possibilities from the Space Shuttle orbiting the Earth to the toaster on your kitchen counter. All great inventions revise civilization by erecting new institutions, establishing new industries, and revolutionizing work, play and manners. Think of the automobile and how it transformed modern life, from the creation of suburbs to the radical change in the way we view distance and time. The atom bomb, in a horrifying way, had the same effect. So did radio, then television. So did the telephone and the airplane. Is the microprocessor of comparable importance? Yes, though its effects are more subtle, often invisible. And like the automobile, a late 19th century invention that reached its zenith in the 20th century, the microprocessor is only now, at the end of this century, coming into its own. Its true impact will only be felt in the century to come. ... The Industrial Revolution, which irrevocably changed the world, was set off by only a 50 times improvement in productivity -- a leap so prodigious that it turned society upside down. By comparison, the microprocessor has improved its performance one thousand times in just twenty-five years. In other words, the developers of the microprocessor have accomplished the equivalent of the Industrial Revolution every two-and-half years. The latest generation of microprocessors already has 100 times the computing power of personal computers of just a decade ago. That is why things are changing so fast around us. And that is why the microprocessor is so important: it is impelling humanity into an era of change the likes of which we never before experienced."

Source: Michael S. Malone, *The Microprocessor: A Biography*, Springer-Verlag, 1995

- "Since the invention of the integrated circuit in 1961, the number of transistors contained in a single chip has increased one millionfold. Today we can produce microprocessors with approximately ten million transistors.; in twelve years we will be able to make them with one billion transistors. ...we can increase the circuit complexity by at least another factor of one million before the silicon-based semiconductor technology, as we know it today, runs out of steam. This means that the practical limit of complexity will be reached about fifty years from now by a chip, actually a cubelet, integrating up to 10 trillion (10,000 billion) transistors."
- Source:** Federico Faggin (considered to be the inventor of the microprocessor), "The Future of the Microprocessor," *Forbes ASAP: The Big Issue*, December 2, 1996, p. 171

- "Today's chips crunch numbers faster than a Cray supercomputer could in the late 1980s. Within 15 years, Intel expects a descendant with a billion transistors that could whip a dozen of today's fastest supercomputers."

Source: "Table: March of the Microprocessor," (includes a table of the growth of the Intel microprocessor), *BusinessWeek*, December 9, 1996

Lasers and Fiber Optics: The Second Driver of the Digital Dawn

- "The arrival of cheap microprocessors in the late 70s, early 80s triggered a decade-long processing revolution. ... The processing revolution yielded to a new revolution, a new period of acceleration triggered by the advent of a fundamental enabling technology - cheap communications lasers. And the advent of cheap lasers served up many things - think about where lasers are hidden today just like microprocessors were once hidden in PC's. Compact disc music players, CD-ROMs, long distance phone calls over fiber optic lines - all these are enabled by cheap laser diodes. And what the advent of cheap lasers did was bring us into a new decade that was an access revolution. And just like in the 80s, the processing revolution, our devices were defined by what the process was. The 90s were defined above all by what they connected us to. And stand-alone anything became

an office oxymoron. And the Internet is a footnote in that because of course it was laser bandwidth that allowed an increase in the size of the Internet backbone and made possible enough telecommunications to do seemingly wasteful things like Gopher and World Wide Web access. Well, we're in the middle of that revolution today and access is everything and the access tail is wagging the computer dog. "

Source: Paul Saffo, "Networking Forum: December 5," interview on November 21, 1995 that appears on the IBM Web Site

- "During the next decade or so, industry will go through a new technological wringer and submit to a new law: the law of the telecosm. The new wringer -- the new integrated circuit -- is called the all-optical network. It is a communications system that runs entirely in glass. Just as the old integrated circuit put entire electronic systems on single slivers of silicon, the new IC will put entire communications systems on seamless webs of silica. Wrought in threads as thick as a human hair, this silica is so pure that you could see through a window of it 70 miles thick. But what makes the new wringer roll with all the force of the microchip revolution before it is not the purity but the price. Just as the old IC made transistor power virtually free, the new IC -- the all-optical network -- will make communications power virtually free. Another word for communications power is bandwidth. Just as the entire world had to learn to waste transistors, the entire world will now have to learn how to waste bandwidth. In the 1990s and beyond, every industry and economy will go through the wringer again."

Source: George Gilder, "Into the Fibersphere," *Forbes*, December 7, 1992.

- "Think of the capacity of fiber as if it were infinite. We literally do not know how many bits per second we can send down a fiber. Recent research results indicate that we are close to being able to deliver 1,000 billion bits per second. This means that a fiber the size of a human hair can deliver every issue ever made of the Wall Street Journal in less than a second. Transmitting data at that speed, a fiber can deliver a million channels of television concurrently -- roughly two hundred thousand times faster than twisted pair. That is a big jump. And mind you, I am talking about a single fiber, so if you want more, you just make more. It is, after all, just sand."

Source: Nicholas Negroponte, *Being Digital*, Alfred Knopf, 1995, p. 23

- "By 2020, there will be so many broadband paths into and out of your home that competition will render bandwidth a commodity of the worst kind, with no margins and no real basis for charging anything. Fiber, satellites, and all sorts of terrestrial wireless systems will pour bits galore into your home. Each channel will have so much spare capacity that measuring available bandwidth will make as much sense as counting photons passing through a window. Scarcity creates value. Since fiber (including transducers) now costs less than copper (except for the shortest lengths), we will be installing fiber even if we do not need the bandwidth it provides. ... Japan will have it in every home by 2015."

Source: Nicholas Negroponte, "The Future of Phone Companies," *Wired*, September 1996, p. 238.

- "In the end, we have to remember that nature has provided us with only one radio spectrum, no matter how cleverly we choose to use it. In contrast, insofar as a single fiber is more or less equal to the whole RF spectrum, the bandwidth of fiber landlines is infinite, since we can keep on making more and more, running the factories three shifts a day, seven days a week."

Source: Nicholas Negroponte, "Wireless Revisited," *Wired*, August 1997, p. 166

- "On February 29, 1996, at the international Conference on Optical Fiber Communications, not one but THREE different lab groups demonstrated TERABIT switches. Fujitsu actually transmitted data 90 miles on a single fiber optic strand, with NO repeaters and NO amplifiers at the 1 TERABIT speed. A Terabit is a THOUSAND GIGABITS or one TRILLION bits per second. ... How fast is a Terabit per second? Well you could carry 22,000 of the 45 Mbps T3 lines in a single fiber optic cable at that speed. ... It is equivalent to 6400 of MCI's 155 Mbps backbone lines."

Source: Jack Rickard, "Editor's Notes: Bandwidth Arithmetic and Mythology," *Boardwatch Magazine*, May 1996, p. 9

- "Just as the integrated circuit made it possible to put an entire computer system on a single sliver of silicon, the all-optical amplifier makes it possible to put an entire system on a seamless seine of silica—glass. Unleashing the law of the telecosm, it makes possible a new global economy of bandwidth abundance. "
Source: George Gilder, "Fiber Keeps its Promise," *Forbes* ASAP, April 4, 1997

Sensors: The Third Driver of the Digital Revolution

- " We're beginning to see the shape of the third revolution. The next big event will be shaped by a third enabling technology, and that's the arrival of really cheap sensors. It's things like video cameras the size of walnuts and cheap enough to be used once and thrown away. And moreover, under deeper technology like MEMS (microelectronic mechanical systems), MEMS looks like a very promising way to build ultra-cheap sensors that sense things like pressure and temperature and fluid flow and acceleration. You'll see it hit first in Detroit. Right now the most popular thing to steal out of automobiles isn't stereos (thanks to the microprocessors, they're too cheap to bother to steal), it's airbags because the airbag sensor is a very expensive bulky device. It's mechanical and awkward. Frankly, it's quite primitive. You could use MEMS technology to build a more accurate sensor that's more accurate and more reliable and cost a fraction of what those airbag sensors cost today. And so suddenly we're headed into this world, a third age enabled by sensors, where suddenly our devices are aware of the world around us. It's a world, for example, of cheap video cameras, but that doesn't mean video cameras where we're all staring at each other on the screens with video conferencing. Something AT&T has tried to do for decades with no result, but rather a world of cameras aimed at everything everywhere, and also hooked to the Internet. So you're not looking at other people necessarily, though you'll certainly do that. Sensors everywhere will constantly report back on what's happening."

Source: Paul Saffo, "Networking Forum: December 5," interview on November 21, 1995 that appears on the IBM Web Site

- "Let me say there will be a demand for a different kind of 500-channel TV. But it won't be 500 channels, it will be 50,000 or more channels all individually pumped out of homes and businesses in much the same way as computer bulletin boards work today. The real action is direct connect: video to PC. These will be computer/video boards -- the VBBS. ... This is the future: TV cameras everywhere all accessible over dial-up lines."

Source: John C. Dvorak, *Dvorak Predicts*, Osborne McGraw Hill, 1994, p. 123

- "Once upon a time the Internet was a vehicle used primarily by college professors to send notes back and forth. Now tens of millions of computers are connected to it. Someday, in principle, just about everything electronic could be connected -- all the world's telephones, pagers, cellular phones, handheld computers, network computers, auto navigators, smart cars, smart cards, televisions, videogame players, and dishwashers. ... Someday you could be E-mailing your microwave oven so the Spaghetti-Os are hot when you get home. Or maybe you will have images of the lower deck of the George Washington bridge sent to a screen in your car as you approach the ramp. Or maybe your life will be saved when your implanted defibrillator sends an Internet message to the nearest ambulance."

Source: Andrew J. Kessler, "How to Address a Dishwasher," *Forbes*, December 2, 1996, p. 246

- "Today a videocam with all the attendant circuitry required to attach it to a computer costs approximately \$9 a unit in OEM quantities. This number will drop precipitously as the next generation packages everything on a single chip. Even the lens will be glued directly to the chip. Cheap video translates into cheap 'eyes.' ... A world of ubiquitous video is not a world of people looking at each other via videoconferencing. Rather it is a world of cameras aimed at everything everywhere, watched over by machines, and only occasionally examined by people."

Source: Paul Saffo, "Sensors: The Next Wave of Innovation," *Communications of the ACM*, February 1997

Moore's Cannibal Principle

- "The whole point of integrated circuits is to absorb the functions of what previously were discrete electronic components, to incorporate them in a single new chip, and then to give them back for free, or at least for a lot less money than what they cost as individual parts. Thus, semiconductor technology eats everything, and people who oppose it get trampled."
Source: Gordon Moore (Intel Chairman) quoted in Brent Schlender, "Why Andy Grove Can't Stop," *Fortune*, July 10, 1995, p. 91
- "The Law of the Microcosm ordains that one-chip systems will be better, not worse, than intersecting boards strewn with devices linked by wires and buses. As Will Corrigan, chief of LSI Logic, observes, "From calculators to cellular phones, every time a system has moved onto a single chip, it has wreaked havoc with the existing industry."
Source: George Gilder, "Goliath at Bay," *Forbes ASAP*, February 26, 1996, p. 114

Wilkie's Dictum

- "'It's as simple as this,' says Brian Wilkie, general manager of Motorola's advanced micro-controller division. 'If there is any point in your production process or in the use of your product that is electrically controllable, then you should immediately assume that one of your competitors is using chips to make that product or process faster, cheaper, more reliable and more user-friendly. And that's just the start. If you can figure out any way to *add* electrical control to manufacturing, production or even distribution of your products, you should do it. Why? Just so you can then put in the chips.' From children's' apparel to currency arbitrage, chain-store retailing to machine tooling, the smartest and best are exploiting chips. If not within products, then in their manufacture, their distribution, their retail sale, their service and support, their marketing or their use by the customer. Today there is at least one semiconductor circuit connected with just about every electrical device or motor on earth. And new product designers, following Wilkie's dictum, have raced to stick the computer intelligence of microprocessors and microcontrollers in the most amazing places: lightbulbs, basketball shoes, ski bindings, clothiers irons, credit cards, pet collars, greeting cards, even human bones, to list just a handful of the thousands of recent uses."
Source: Michael S. Malone, "Chips Triumphant," *Forbes ASAP*, February 26, 1996, p. 53

Plummeting Price of Bandwidth

- "Just as the old integrated circuit made computing virtually free, the new all-optical network will make communications power virtually free. The working of this law will render obsolete the entire idea of scarce spectrum and launch a new era of advances in telecommunications comparable to recent gains in computing."
Source: George Gilder, "Into the Fibersphere," *Forbes*, December 7, 1992
- "You think computer prices are plummeting. Wait until you see what happens to bandwidth."
Source: Andy Grove, Intel CEO, quoted by George Gilder, "Life After Television," *Forbes ASAP*, February 23, 1994
- "We'll have infinite bandwidth in a decade's time."
Source: Bill Gates, Microsoft CEO, quoted in *PC Week*, October 11, 1994, p. 79.
- "High-performance Internet access (ISDN or better speeds) will be delivered to the home for as little as \$15 to \$20 per month in 1996, down from \$25 to \$70. Pricing will drop to \$10 to \$15/month within the next two years. There will be one major driver: cable companies (with the help of affordable cable modems) playing the Internet card as their first foray in the telecommunications business."
Source: Frank Gens, "Predictions '96: A Pivotal Year As the Industry Shifts Gears," *International Data Corporation*

Death of Distance

- "Relentless technological change is driving down many of the elements in the cost of a telephone call. Already, the cost of carrying an additional call is often so tiny that it might as well be free. More significantly, carrying a call from London to New York costs virtually the same as carrying it from one house to the next. The death of distance as a determinant of the cost of communications will probably be the single most important economic force shaping society in the first half of the next century. It will alter, in ways that are only dimly imaginable, decisions about where people live and work; concepts of national borders; patterns of international trade. Its effects will be as pervasive as those of the discovery of electricity."

Source: "The Death of Distance," *The Economist*, September 30, 1995, Telecommunications Survey page 5.

- "For four decades, nearly every phone company has had a long-distance pricing structure that has pushed people to make calls at certain times. ... But the days of bending to phone company calling schedules are history ... we're rapidly heading toward free long-distance calling all the time, nationwide. Free. Zip. First of all, it's important to know that there was never any reason for time blocks anyway. ... A lot of people assume that the time slots were created by AT&T in its monopoly days to balance the load on its network. ... But AT&T network experts say that's not true. The network was never in danger of jamming. At best, the time slots were an effort to generate traffic during nighttime lulls. ... 'It was monopoly economics,' says Jack McMaster, AT&T vice president for consumer long-distance. ... 'Now it's different. It's becoming market-based economics.' ... There is now so much excess capacity in the nation's long-distance networks, it's as if there were entire interstate highways out there with no cars on them. Thanks to fiber optics and computerized switching, the cost of transmitting a call -- just moving that signal from one place to another -- is about a half-cent a minute. That cost barely changes no matter what time it's transmitted or how far it goes."

Source: Kevin Maney, "Grandma Sleeps: AT&T Move Wakes Up Long-Distance," *USA Today*, October 3, 1996, p. 5B

- "One, is the tariff model out of date? The whole telephone industry is out of date! It was a wonderful model for a hundred years. Now we've gone through a nice transition with long distance, and it's time for local telephone transitions. And when that opens up, prices will fall, services will be created, and it will be chaotic, but for us it will be marvelous. We love the chaos and it will open up all kinds of opportunities. So yes, probably the tariff model is old. When you move into the data world -- why are we measuring minutes? Think of it: you can send a packet in a minute that is just a monster and eventually you could move a movie in a couple of minutes. And you're going to pay for a minute of this service, or are you going to pay for the bandwidth that you use to go there? We're looking at that now within our billing system -- minutes are antiquated, not to mention the tariff tables. What isn't antiquated are bits. That's where it's going to go. You're going to pay for either the content or the volume. You're probably going to pay for information -- some combination of bits, and how good the bits are, and when you got them, and at what speed, and were they accurate when you received them. And so you try to translate that into the business functions in order to figure out how to build that stuff. And that's not easy."

Source: John Gerdeman (president of networkMCI, quoted by Michael Vizard and Jessica Davis, "NetworkMCI's Gerdeman on Who Will Pay for the New Internet," *Infoworld*, October 21, 1994, p. 1

- "what should it cost to communicate? At present, the answer depends on how you do it. Pick up the telephone, and you pay by the mile and the minute. Send a message across the Internet to the same destination (or use special software to make an Internet telephone call) and--even though the message will travel across the same lines--you pay, at most, the price of a local telephone call. In part the cheapness is because the Internet sends messages more efficiently than local telephone networks: it breaks them down into small digital "packets" that can then be slotted in with other packets travelling over the same network. By contrast, a telephone call requires a whole electronic circuit to itself for the duration of the call. But in long distance and international transmissions, the

technology is similar: both voice and data are sent as a digital stream along fibre-optic cable. Indeed, nearly all of the Internet runs along lines leased from the telephone companies. Both telephone companies and the myriad firms that run the Internet therefore have a similar pattern of costs: their big expense comes in installing switches (or "routers") and providing lines. The cost of carrying one extra item is as near to zero as makes no difference--"too cheap to meter", as some would have it. But if the costs of the telephone companies and the Internet are similar, why are their methods of pricing different? The answer is that telecoms charges bear little relation to costs. The telephone industry is regulated nearly everywhere and in most countries prices are set by bureaucrats and commissions; real costs are hidden by a layer of cross subsidies. The Internet, on the other hand, is essentially unregulated. ... What seems reasonably certain, however, is that the impact of the Internet and the spreading deregulation of the telecoms industry will bring prices closer to real costs."

Source: "Too Cheap to Meter?" The Economist, October 19, 1996, p. 23

- "For consumers, the international rate system has been a mystery for years. Why, for example, does it cost \$1.50 to place a five-minute call to Los Angeles from New York, but \$5.79 to call London from New York, which isn't all that much further? The answer: The second call is subject to archaic and bizarre rules that have let national phone monopolies charge exorbitant rates for years, making overseas phone calls the most profitable kind of service. An international cartel, originally formed by 20 European phone companies in 1965, sets these rates, and because government-owned phone monopolies use them to subsidize their local services and even other public projects, few cartel members have ever complained. ... Such skewed costs have little economic rationale. Technically, the cost of patching through a long-distance call should be about the same as a local call. Both go through the same sort of computer-dispatching system. International callers, though, still are charged by the length of their call and the distance they cover."

Source: Gautam Naik and Kyle Pope, "Global Merger Could Lower Overseas Rates," *Wall Street Journal*, November 5, 1996, p. B1

- "If a single glass fiber can carry all the voice, fax, video and data traffic for a large corporation yet costs little more than today's high-speed Internet connections, how much will they be able to charge for telephone service? Peter Cochrane of BT Laboratories in Ipswich, England, predicts that "photonics will transform the telecoms industry by effectively making bandwidth free and distance irrelevant." Joel Birnbaum, director of Hewlett-Packard Laboratories, expects that this will relegate telephone companies to the role of digital utilities. "You will buy computing like you now buy water or power," he says. Others, such as industry analyst Francis McInerney, believe the double-time march of technology has already doomed them to fall behind. AT&T and its ilk, he claims, "are already dead. When individuals have [megabits per second of bandwidth], telephone service should cost about three cents a month." Having discovered how to offer high-bandwidth service, telephone companies may now need to invent useful things to do with it, just to stay in business."

Source: W. Wayt Gibbs, "Bandwidth, Unlimited," Scientific American, January 1997

Rise of All-optical Network

- "An all optical network would provide so much capacity that the exchange of video and large computer files would become routine. A video camcorder owner could plug the camera into a cable wall outlet and have relatives across the country participate in a child's birthday through video linkages. In fact, one can only begin to imagine the uses for a network in which bandwidth becomes as inexpensive as electricity, gas or water."
- Source:** Vincent Chan (MIT Professor), "All-Optical Networks," *Scientific American*, September 1995, 72-74
- "The all-optical network will triumph for the same reason that the integrated circuit triumphed: It is incomparably cheaper than the competition. Today, measured by the admittedly rough metric of mips per dollar, a personal computer is more than 2,000 times more cost-effective than a

mainframe. Within 10 years, the all-optical network will be thousands of times more cost-effective than electronic networks. Just as the electron rules in computers, the photon will rule the waves of communication.

Source: George Gilder, "Fiber Keeps its Promise," Forbes ASAP, April 4, 1997

Plummeting Price of Storage

- "Prices keep falling. For 3.5 inch hard drives of 3 gigabytes or larger capacity (price per megabyte):

1991	\$5.00
1994	\$0.26
1996	\$0.10
1998	\$0.03

Source: "Holograms and Atoms," Forbes ASAP, June 3, 1996, p. 126

Demise of Desktop Computer Industry

- "The desktop computer industry is dead. Innovation has virtually ceased. Microsoft dominates with very little innovation. That's over. Apple lost. The desktop market has entered the dark ages, and it's going to be in the dark ages for the next 10 years, or certainly for the rest of this decade. ... Eventually, Microsoft will crumble because of complacency, and maybe some new things will grow. But until that happens, until there's some fundamental technology shift, it's just over."
Source: Steve Jobs, interviewed by Gary Wolff, *Wired*, February 1996, p. 102.

Demise of the Telephone Switch

- "Paul Green Jr. ...IBM's manager of advanced optical networking, is working on a radical new technology for the 'wires' that link his network. His project, dubbed 'Rainbow,' involves the arcane physics of light traveling on strands of glass. But his ambitions are anything but arcane: As he sees it, Rainbow will loosen the phone companies' stranglehold on the fiber-optic networks they use to send phone calls and other messages. He wants to throw these networks open -- at staggeringly cheap rates -- directly to customers, letting them someday send videos, encyclopedias and CAT-scans as easily as they send faxes today. Behind Dr. Green's vision are two battles: one scientific, one political. The scientific struggle involves his alternative design for the 'traffic cop' that sorts and controls messages on the phone network. Today, the phone industry does this job with big computers called switches. Messages course through the fiber-optic network in the form of flashes of light. The switches take the light signals, converted to electronic data, and send them all to the right destinations. Normally, messages can't get on or off the optical fibers without going through a phone company's switch. Rainbow dispenses with the computerized switches. Instead, it borrows an analogy from the world of radios. Just as each radio station broadcasts on only one 'band' of the radio spectrum, each phone user would be able to tap directly into the optical fiber network and transmit his call on one 'channel' of the light spectrum. On the other end, the recipient would use an optical 'tuner' to dial across the spectrum and pick up the correct channel. The political battle is much more complex. Dr. Green thinks the phone industry has limited what customers can send to each other by forcing everything to go through its switches. 'Get the phone company out of the way!' he cries."
Source: Michael W. Miller, "Technology -- In the Lab: Scientist Seeks Broader Access To Fiber Optics," *Wall Street Journal*, Feb. 17, 1993, p. B1

- "Global competition is driving the research community to trade off pure research for product R&D, and IBM Research is not immune to the phenomenon. In its latest attempt to commercialize technology that the IBM Research community might once have pursued as merely interesting, the information-technologies giant is making a case for the all-optical network. The research arm

plans to sell fiber-optic multiplexers based on wavelength-division multiplexing (WDM) to anyone willing to pay for the still high-priced technology. WDM, when perfected, would be able to divide a fiber's 25,000-GHz theoretical capacity into 10,000 1-Gbit/second connections, spaced 120 GHz apart. "That's enough capacity to transmit 10,000 uncompressed HDTV channels on a single fiber," said Paul Green Jr., manager of IBM Research Advanced Optical Networking. "Or you could sustain all the telephone calls in that fiber during Mother's Day, the busiest call day of the year."

Source: Nicolas Mokhoff, "[IBM develops all-optical network](#)," EE Times Interactive, February 6, 1995, p. 35

Demise of the Circuit Switched Network

- "once the bandwidth bottlenecks are ironed out, all voice, video, data and other communications will route through the Internet cloud. The current circuit switched network will disappear entirely."

Source: Jack Rickard, Publisher/Editor, *Boardwatch Magazine*, May 1997, p. 11

- "At the Business Online '97 event last week, global consulting firm Arthur D. Little issued a rather blunt warning for the telecoms industry. Werner Knetsch of the company, in his keynote speech, ... said that his company perceives the Internet as the architectural platform with the potential to provide multimedia services to the end-user market. Dr. Knetsch, who is head of Little's global telecoms, information technology, media, and electronics practice, said that the telecoms industry must stop regarding the Internet as a peripheral phenomenon for computer freaks, or as a platform for online services, at best. 'Quality, clarity, and other characteristics of voice on the Net are expected to improve quickly, and the Net offers a host of other applications that are improving rapidly as well -- so the telecoms industry is in danger of losing a significant proportion of its revenues and its ability to offer value-added services competitively,' he explained."

Source: Sylvia Dennis, "Internet Used As Telecoms Trojan Horse," Newsbytes News Network, May 7, 1997

Rise of Network-Centric Computing

- "'One of the great things about this industry is that every decade or so, you get a chance to redefine the playing field,' Lou Gerstner (IBM CEO) told Business Week in an exclusive interview. 'We're in that phase of redefinition right now, and winners or losers are going to emerge from it.' The driving force is the arrival of low-cost digital networks that are spreading everywhere. Using high-speed fiber-optic cables and lightning-fast switches, digital networks will carry a whole new host of communications-based applications, such as teleradiology, distance-learning in the education market, or electronic transactions in business. Network-centric computing, as Gerstner calls it, is remaking the computer business the way the low-cost power of the microprocessor overwhelmed the mainframes and minicomputers of the 1980s. ... 'What is every major institution in the world focusing on?' asks Gerstner. 'It's call reengineering. It's called getting competitive. It's called reducing cycle time and cost, flattening organizations, increasing customer responsiveness. All of these require a collaboration with the customer and with suppliers and vendors.' All of these efforts, in short, depend on networking. ... In the wired future, says Gerstner, companies will be able to buy computing power and applications software the way they buy electric service. 'They will rent them on a per-usage basis because they will be resident in the network,' predicts Gerstner. 'Think about the implications of a world in which the application is on the server -- all applications.'"

Source: Ira Sager, "The View From IBM," *Business Week*, October 30, 1995, p. 142

- "There will be networked PC servers 'in nearly every office, manufacturing facility, store, school and home' by the end of the decade, according to Echard Pfeiffer, president and CEO of Compaq Computer Corp. ... Pfeiffer told Innovate Forum 95 attendees the boundaries between private and public networks and between personal and corporate computing, as well as between the computer and the network, will dissolve as we head towards the 21st century. Pfeiffer also predicted the

evolution of a new distributed enterprise computing model in which 'corporations would run their businesses using an array of hundreds, even thousands, of specialized application servers: mail messaging servers, gateway servers, decision support servers, video and Internet servers.'"

Source: Mim Mallory, "Networks Everywhere, Says Compaq Boss Following Record 3Q," Newsbyte article, October 17, 1995

- "You buy whatever phone you want; you plug it in; it works. When the companies offer some new service--call forwarding, voice mail--you don't have to buy extra memory chips for your phone or get an upgrade for your telephone software, as you would in the computer world. You keep using your old phone. And so it could be in the world of computers, according to the Java theory. Java is a way to let your computer borrow and use programs that exist on the central network--like the switching and call-forwarding programs on the telephone network--even though you have never bought or installed them. If you were working on a financial problem, you might locate an Internet site that had data you wanted. Using the Java protocol, that site would instantaneously ship you the most up-to-date version of the particular spreadsheet or statistical routines you needed to analyze the data. When these "applets," or small program components, had solved your problem, they would disappear from your machine. Presumably, in some way not yet specified, you would pay a small fee somewhere, as you do for use of the different services available by telephone. You wouldn't need to worry whether you had found the right files for the latest release of your favorite program. Your computer wouldn't need to be a huge battleship, with more raw power than ran the Apollo project and with hard drives capable of storing gigabytes of complex programs. It would simply need to be able to connect to the Internet and receive and run programs sent by Java (which is compatible with nearly any kind of computer and nearly any operating system). Conceivably Java could lead to the production of stripped-down "Internet terminals," costing \$500 or so, which could turn up where pay phones do today. Rather than take portable computers with them, people could send messages from an Internet terminal in one airport as they departed and collect them from another after they arrived. "

Source: James Fallows, "The Java Theory," *Atlantic Monthly*, March 1996

Rise of Networks as Supermarkets

- "Price-performance ratios are not longer used to justify the utility of networks. Rather, time to market, competitive advantage, real-time warfare strategy, and quality are the factors that necessitate networking. Competitive forces are so strong that cable TV, telephone, and computer companies are all vying for dominance in new networking ventures. They see networks as the supermarkets of the future, a way to more competitively distribute their products."

Source: Ted G. Lewis, "Where is Computing Headed," *IEEE Computer*, August 1994, pp. 59-64.

Rise of the Internet

- "In the 20th century, we have been without any mass medium for serious discourse -- until the creation of the Internet."
- Source:** Alan Kay, *Wired*, September 1995, p. 36
- "Like the PC, the Internet is a tidal wave. It will wash over the computer industry and many others, drowning those who don't learn to swim in its waves."
- Source:** Bill Gates, "Never Underestimate the Power of the Internet," article distributed by The New York Times Syndicate, August 1995.
- "A new survey from Straightline International claims that more than three quarters of US companies are either already on the Internet or will be on the Net within two years. Seventy-seven percent of the companies surveyed said they would be in cyberspace by 1997. ... 38 percent said they already had Internet World Wide Web sites, while 39 percent said they'll have Web presences within two years. ... One survey result found to be a bit surprising is the fact that many of the sites are being initiated by investor relations or management information systems, instead of marketing departments."

Source: Bob Woods, "77% of US Firms in Cyberspace by 1997," Newsbyte article October 20, 1995.

- You've got a fundamental transformation under way in about five industries that are going to all embrace this technology (the Internet and the Web). There's the telecommunications industry, which is a couple of trillion dollars worldwide. The media industry, starting with publishing and going on to broadcast media -- I guarantee you digital television will be delivered through these kinds of mechanisms, and voice communication is going to occur this way, too. Third is general services -- travel services, information services, financial services. Fourth is software -- desktop software itself is going to get a hell of a lot cheaper. ... So, the software industry is going to go through a massive change, and that's going to affect us all. And, finally, consumer electronics is going to embrace this technology. Televisions are going to have built-in Internet interfaces. So when you have that much of the world economy undergoing transformation, there are some opportunities there somewhere.

Source: Jim Clark, Chairman of Netscape Communications Corp., quoted by Don Tennant, "Netscape's Jim Clark Takes Bill Gates to Task," *Infoworld Electric*, February 9, 1996

- "The worldwide Internet market will show an explosive 77% growth rate over the next five years, according to INPUT, an IT market research and consulting firm. In a market sometimes characterized by Web site skepticism, the expectation of Internet users is that over \$200 billion will be spent on Internet hardware, software and services in 2000. According to Brad Meinert, INPUT's Internet Program Director, 'Those companies who don't believe the Internet will pay off are simply looking at its external use. Internet technology will be used extensively within the corporation as an application development platform, and will continue to threaten popular enterprise applications such as Lotus Notes and SAP.'"

Source: "Internet Market will Grow to Over \$200 Billion by 2000," Business Wire article, March 18, 1996

- "If you had the only telephone in the world, who would you call? Networks seem to grow more valuable to a user proportionately with the number of other users he or she can call. In a network with N users, each sees a value proportional to the N-1 others, so the total value of the network grows as $N*(N-1)$, or as N squared for large N . This brilliant 15-year-old observation was recently named Metcalfe's Law."

Source: Bob Metcalfe, "From the Ether Metcalfe's Law: A network becomes more valuable as it reaches more users," *Infoworld*, October 2, 1995

- "I think the Internet is going to dramatically change:
 - Telecommunications infrastructure
 - Distribution systems of all kinds by entirely flattening distribution worldwide.
 - Centralized news distribution systems
 - All financial markets and investment/trading scenarios."

Source: Jack Rickard, Publisher/Editor, *Boardwatch Magazine*, May 1997, p. 11

Rise of the Broadband Internet

- "Recall that the key question in providing residential Internet access is what kind of network technology to use to connect the customer to the Internet Point of Presence. For residential Internet delivered over the cable plant, the answer is broadband LAN (Local Area Network) technology. This technology allows transmission of digital data over one or more 6 MHz channels of a CATV cable. Since video and audio signals can also be transmitted over other channels of the same cable, broadband LAN technology can co-exist with currently existing programme services. Broadband LANs were deployed in the 1980s by customers with large campuses, such as universities, manufacturing plants, and military bases, for whom integrated transmission made more economic sense than stringing multiple long wires."

Source: "Internet Access Over the Cable Plant," Videotron Communications Ltd., February 9, 1996

- "Phone lines that carry 6,312 Kbps. That's the promise of AT&T Paradyne's new GlobeSpan transceiver chip set. GlobeSpan uses a technology called asymmetric digital subscriber line (ADSL) over ordinary phone lines, eliminating the bother of rewiring the entire planet with fiber-optic cable. The one-way data speeds would be up to four times as fast as a T-1 line and about 400 times faster than a 14.4 modem. Return bit rates would be about 64 kbps (hence the 'asymmetric'). ... A related technology, symmetric digital subscriber line (SDSL), may be even more attractive to some users. SDSL allows two-way bandwidth on the order of fractional T-1. This would allow, for example, live videoconferencing at home. AT&T Paradyne will support ADSL, HDSL, and SDSL within the same chip set. With this kind of bandwidth, on-line providers are thinking of producing their own programming. If the modem and service are inexpensive enough, the Internet will become far more attractive as a medium for audio and video broadcasting."

Source: "AT&T Paradyne's Bandwidth Revolution," *Byte*, February 1996, p. 60

- "GTE Corp. is running a trial of an Internet and remote LAN access service that gives users full 4M bit/sec bandwidth over conventional telephone lines. The Asymmetric Digital Subscriber Line (ADSL) trial in the Dallas-Fort Worth area is the first to focus on using the technology to support data services."

Source: Tim Greene, "GTE Off and Running in Fast Internet Trial," *Network World*, February 19, 1995

- "The Internet exploded, and ADSL vendors introduced sophisticated new modulation and compression techniques. New transceivers (modems) are rolling off production lines this summer, and phone companies are replacing their 1.5Mbps downstream/64Kbps upstream models with 6Mbps/640Kbps versions. That's enough power to deliver several MPEG 2 video streams while simultaneously letting users download Web pages and talk on the phone. And the 640Kbps upstream path enables high-quality videoconferencing. ... The major question surrounding ADSL's future is whether modem costs -- now in the thousands of dollars -- will drop fast enough. Motorola's Sallee says that company's single-chip solution will mean \$250 to \$300 ADSL modems in two years. At those prices, they should be competitive with cable modems, prompting the pipeline wars to begin in earnest."

Source: Eric Brown, "ADSL Jumps Into the Race," *New Media*, September 30, 1996

- "Ray Smith, chairman and CEO of Bell Atlantic Corp., today outlined new communications technologies that will provide corporations and consumers with affordable and high-speed Internet access. Smith said Bell Atlantic will roll out ADSL (asymmetrical digital subscriber line) technology that lets users integrate voice and data on existing phone lines. This will take place soon after Bell Atlantic and Nynex Corp. complete their merger, expected by next month ... A move to the nascent ADSL technology should greatly boost speed. ADSL runs at 6M bps, while Bell Atlantic today offers only 128K-bps ISDN for voice, data and video over existing phone lines. At current test sites, ADSL costs about \$60/month. Final pricing is not set for the service, which will be generally available by the end of the year. Smith also said that Bell Atlantic later this year will roll out its switched broadband network, a 52M-bps service currently being tested in Philadelphia."

Source: Stephanie LaPolla, "Bandwidth boost ahead, according to Bell Atlantic CEO Ray Smith," *PC Week Online*, March 18, 1997

- "John Doer of Kleiner Perkins Caufield & Byers says 'Let's start an industry.' ... @Home is Doerr's new broadband Internet company. Milo Medin is Doerr's weapon to break the bottleneck (of today's narrowband Internet). ... Leasing capacity from the telephone companies, @Home will create a new broadband network. ... Over the next two years, Medin plans to upgrade his backbone to 622 megabits a second. Most important and revolutionary, though, are Medin's plans for the local loops and service providers of the Net. ... @Home distributes intelligence and memory through the network. ... 'You have to think of it as a distributed computer system. In such systems, every processor cannot access memory at once. You build caches and shared-memory protocols and you mirror and replicate a lot of the data so that it's always available locally. That's what

you're going to have to do on the Internet.' In other words, the Internet is a computer on a planet. ... For a total investment of less than \$188 million, Doerr claims @Home can launch a business yielding at least \$500 million in cumulative revenues by the year 2000. Later this year, depending on cooperation from other cable companies, the entire state of Connecticut will move onto broadband two-way cable. ... By the turn of the century, @Home hopes to extend service to all the major urban and suburban centers. ... Today, the bulk of bandwidth to homes is coaxial cable laid over the last 25 years by cable television industry. Exploiting that bandwidth for the Internet is the single greatest opportunity in the history of information technology. ... Scott McNealy (CEO of Sun Microsystems, Inc.) said 'The power of a network comes from the number of nodes times the bandwidth. By this measure, the @Home opportunity is as big as there is.'

Source: George Gilder, "Goliath at Bay," *Forbes ASAP*, February 26, 1996, pp. 101-117

- "In a keynote speech in front of a packed house at San Francisco's Netscape Developer's Conference Wednesday, Sun Microsystems' Eric Schmidt painted a picture of an Internet-, intranet-, and Java-dominated future that he says could topple the client/server model and seriously threaten the Microsoft/Intel-dominated PC platform. ... Schmidt said the current Internet market is 10 percent of the total available market and pointed to some key signposts of the Internet's future: 1) Internet everywhere, including lower-end Internet appliances; 2) online "meaning" Internet; 3) price-based Internet services; 4) integrated Internet yellow pages (five vendors announced plans for yellow pages last week; and 5) live virtual reality-based communities. He also focused on solutions to existing bandwidth problems and bottlenecks. Cable modems--as opposed to "unfriendly" ISDN--figured big in his perception of the Internet's future. He pointed to promising cable-modem trials in Sunnyvale, California, and described the guts of the typical cable as consisting of a television line for NTSC video signals, a second phone line, and an RJ45 plug for 10BaseT Ethernet."

Source: "Sun's Schmidt Points to Paradigm Shift," PC Online, March 6, 1996

- "I look for cable tv companies, long distance telephone companies, local telephone companies, and even brazen entrepreneurs in pickup trucks to start knocking on your door offering everything up to and including 155 Mbps Synchronous Optical Network (SONET) connections at \$30 per month before it is all over. By Christmas? Not likely. But it will happen. And bandwidth across the board will increase by at least one order of magnitude every two years.

	Backbone	Home Users
1996	45-155 Mbps	28.8 kbps
1998	500 Mbps	288 kbps
2000	5 Gbps	2.88 Mbps
2002	50 Gbps	28.8 Mbps
2004	500 Gbps	288 Mbps
2006	5 Tbps	2.88 Gbps

As you can see, about the year 2005, things would be moving along pretty nicely. Also, about the year 2000, video over the net - very high quality video along the lines of high-definition television - start to look very real. I'm seeing visions of digitized versions of servers with every movie ever made available for a buck - with huge search engines to help you find the specific scene in the specific movie where the term 'make my day' first appeared."

Source: Jack Rickard, "Editor's Notes: Bandwidth Arithmetic and Mythology," *Boardwatch Magazine*, May 1996, p. 109

- "How about geostationary satellites? Hot on the heels of DirecTV and its announcement this month of DirecPC, Hughes Communications Inc. is now planning Spaceway, another exciting satellite service. Spaceway will offer 92Mbps Internet access directly to homes via geostationary satellites. Spaceway's two-way digital dishes will cost less than \$1,000 and could be in service by as early as 1999. ... The HS702 is the geostationary satellite through which Spacewaybits will flow. Four pairs of HS702s costing \$3 billion will redundantly cover the world. Each HS702 is expected to keep 48 of its 64 125-MHz transponder beams in operation for 15 years. Each downlink beam is 92Mbps, for a total of 4.4Gbps per satellite, 35Gbps worldwide. ... So, at 92Mbps, will Spaceway be the way to connect to the Internet? No. When it comes to stationary

point-to-point transmission, optical fibers outshine wireless. The sky would be black with HS702s if Spaceway were used for megabit Internet service for even a small fraction of U.S. households. Still, Spaceway is something to look to, especially for highly mobile or remote applications."
Source: Bob Metcalfe, "Hughes Satellite Gives Telcos, TV Companies Needed 'net Competition,'" Infoworld, October 28, 1996

- "Imagine information traveling a million times faster than today's modems. The National Aeronautics and Space Administration (NASA) and five other US government agencies are doing more than imagining, working on a "new" Internet that will operate at these speeds within five years. NASA's Ames Research Center here is leading the research and development efforts on the Next Generation Internet (NGI) initiative that could, by 2002, result in information flowing a million times faster than today's modern home computer modems and 1,000 times faster than a current standard T1 business computer line, they say."
Source: Bill Pietrucha, "Internet - The Next Generation A Million Times Faster," Newsbytes News Network article, February 24, 1997

Rise of Wireless Internet

- "Electronics companies are betting that a data revolution will transform wireless communications in much the same way that the Internet and networking have changed the way people use conventional phone lines. Prospects of a cellular data boom are already shaping the phone and handheld computer markets. ... 'What we are going to see is the untethering of the Internet into mobile devices,' says Jeffrey A. Schlesinger, an analyst at UBS Securities. 'It is poised to happen.'"
Source: Douglas Lavin, "Wireless Industry Is Heeding the Call of Data Revolution," Wall Street Journal, March 12, 1996, p. B6
- "Visual Communications Network is launching what it says is the world's first wireless multimedia, digital network capable of delivering full-motion video. Operating at more than 180 times the speed of an integrated services digital network (ISDN) line, the company's high bandwidth network offers videoconferencing, data storage and retrieval systems, and Internet access to commercial customers. 'This is my dream, my vision,' exclaimed Michel Bowman-Amuah, president of Visual Communications Network. 'With this offering, we have eliminated the limitations of wireline fiber-optic requirements which have held electronic communications to a slow and boring presentation.' ... 'Our wireless network can deliver data at 10 megabits-per-second (Mbps) and on the backbone operate at 1.6 gigabytes-per-second (GBps).' ... Visual president, Michel Bowman-Amuah, told Newsbytes that he plans to have wireless service from every major US city by the end of 1996."
Source: Patrick McKenna, "High-Speed Wireless, Digital Internet Access," Newsbytes News Network, March 13, 1996

Rise of the Web Dial Tone

- "The most exciting things happening today are objects and the Web. The Web is exciting for two reasons. One, it's ubiquitous. There will be Web dial tone everywhere. And anything that's ubiquitous gets interesting. Two, I don't think Microsoft will figure out a way to own it. There's going to be a lot more innovation, and that will create a place where there isn't this dark cloud of dominance."
Source: Steve Jobs, interviewed by Gary Wolff, *Wired*, February 1996, p. 102
- "SunSoft president Janpieter Scheerder and other key software executives and technologists mapped out Sun's comprehensive plan for establishing the 21st century computing equivalent to today's dial tone -- called the "WebTone" -- that will give companies and institutions round-the-clock network dependability for communicating internally and conducting business with suppliers, customers and partners. Sun also announced new web server and security products that are essential for maximizing information flow and business efficiency in a web-based

networked world . . . Sun described the "WebTone," the 21st century equivalent to today's dial tone that facilitates information flow across a multitude of devices from smartcards to supercomputers. The three characteristics of the WebTone are:

- It's always there, like the dial tone.
- It provides services to business and consumers via the web-based network.
- It's accessible from any device (i.e. phones, kiosks, PDAs) anywhere, anytime."

Source: "Sun reveals software strategy for establishing "WebTone" future of computing," Business Wire article, April 15, 1997

- "NORTHERN TELECOM, the Canadian manufacturer of telephone equipment, grew to \$13 billion in sales, mostly by making equipment for voice telephone circuits. But that is yesterday's industry. John Roth, the company's 55- year-old chief executive, vows this 103-year-old company is going to do even better in tomorrow's communications industry. Voice circuits will be swallowed up into a giant data network. This super network will connect just about everything electronic—computers, phones, home security alarms, televisions, even dishwashers. What's a Web tone? An electronic signal that announces the immediate availability of not just telephone service, but Web pages, E-mail, faxes, video, home banking and every other kind of digitized information. Like a dial tone, a Web tone will be available in as little time as it takes to pick up the phone. (In other words, no more time wasted logging on to the Internet.) Also like a dial tone, Web tones will be practically everywhere, accessible in at least as many places as conventional or wireless phones are today. Roth promises that it will all happen in less than ten years."

Source: Scott Woolley, "Dial tones? No, Web tones," *Forbes*, January 26, 1998

Rise of Internet Telephone


- "If you really want to save money on long-distance calls, you might want to check out a new telephone giant that's offering communication services worldwide. It already has about 30 million subscribers. Some experts predict it will have more than 200 million by the end of the decade, making it the fastest growing network of all time. And it won't drive you crazy with idiotic commercials about paltry savings on long-distance calls. If you haven't already guessed, the new telephone giant is the Internet. With special phone software, you can now call virtually anywhere, anytime, and talk for as long as you want -- free! You're not even charged extra on your Internet account."

Source: Nathan Muller, "Dial 1-800-Internet," *Byte*, February 1996, p. 83

- "Now it's possible to check phone messages from the Internet's World Wide Web with new software from IBM. Voicemail users can now listen to, delete and save their messages directly from their computers using web browsers such as those in the IBM Internet Connection family."
- "Microsoft and Intel Corp. said they would promote a series of technical standards to make it easier to use the Internet as a medium for making phone calls and for video conferencing. The two industry giants said they would integrate the communications technologies into future Microsoft operating systems and specifications for PCs that use the Intel chips, starting next year."
- "Netscape Communications within six months will build voice software for making low-cost long distance calls via the Internet into its Navigator program, the company's co-founder and vice president of technology, Marc Andreessen, said at a technical forum in Australia. ... 'We're going to build the voice telephony stuff into our Navigator (software). We can get it out to 25 or 30 million desktops in the next six months. That's a big enough critical mass for it to take off,' he said, according to the newspaper. He predicted phone companies would find much of their equipment 'rapidly becoming useless.'"

Source: "Netscape To Build Telephony Into Navigator," Newsbytes News Network, March 13,

1996

-  "The existing phone network was for the 20th century,' Darryl Green, president and chief executive of AT&T Jense, an AT&T Corp. venture in Japan offering Internet telephony. Internet technology, he says, is 'the network for the 21st century.' ... According to the International Telecommunications Union, the Geneva-based association of the world's traditional phone companies, it costs 15 cents to switch a kilobyte of data using traditional means, but only four cents via so-called Internet packet-switching. And because the Internet is a network of many, many interlinked networks, even tiny providers can plug into its vast geographical reach without making massive investments of their own. ... Technologist futurist George Gilder describes the trend bluntly: Traditional networks, he says, 'are the wrong pieces, on the wrong board.' Instead, 'the game is Internet protocol packet data over fiber optics.' Translation: Anything old-style phone networks can do -- zap phone calls, dispatch faxes -- the Internet will one day do better."
Source: Gautam Naik, "Internet Phones Are Catching On as Global Experiment," *Wall Street Journal*, November 24, 1997, p. B6

Rise of Digital Agents

- "The "information highway" will present us with an explosion of new computer-based tasks and services, but the complexity of this new environment will demand a new style of human-computer interaction, where the computer becomes an intelligent, active and personalized collaborator. Interface agents are computer programs that employ Artificial Intelligence techniques to provide active assistance to a user with computer-based tasks. Agents radically change the current user experience, through the metaphor that an agent can act as a personal assistant.."
Source: Pattie Maes, "Agents That Reduce Work and Information Overload," Communications of the ACM, Vol. 37, No.7, July 1994
- " ... you can imagine thinking of an intelligent landscape inhabited not only by humans but by smartifacts - artifacts that are intelligent enough to have some degree of autonomy. And it will be decades and decades before we have agents or devices intelligent enough to make people nervous. But we already have devices today that are sufficiently autonomous that they do things for us that are practical. My Wildfire agent really is completely practical even though all it is is a bunch of voice cards in a Pentium box."
Source: Paul Saffo, "Networking Forum: December 5," an interview published in the IBM Networking Forum.
- "With some 16 million pages on the World Wide Web, a gazillion entertainment titles, and oceans of data on big-ticket products like cars, soon we will need the rest of our lives to find what we want. For many years, performing this hunter-gatherer function has been the promise of software agents. Researchers have long promised that these chunks of computer code, imbued with your preferences and the authority to make decisions about them, will be able to comb computer networks and data to deliver to you the information, products or services you want, without requiring your active involvement. These agent-based services, now coming to market, could radically increase the utility of the Net if they work as promised."
Source: Denise Caruso, "In a Sea of Web Data, a Sudden Flash of Light," The New York Times Cybertimes, January 29, 1996

Rise of the Teleputer

- "Within four years, personal-computer users will be talking to Walkman-like portable devices that are phone, fax, computer, stereo and television all in one."
Source: Eckhard Pfeiffer, CEO of Compaq Computer Corporation, quoted in Scott McCartney, "Compaq's CEO Sees Pcs Reshaping Our World Into One Like George Jetson's", *Wall Street Journal*, June 20, 1995, p. B5

- "The PC is it. We can make it so superb as an entertainment machine, and so vital as a communications medium for both the home and the workplace, that it will battle with TV for people's disposable time."
Source: Andy Grove (Intel CEO) quoted in Brent Schlender, "Why Andy Grove Can't Stop," *Fortune*, July 10, 1995, p. 90
- "We describe the future in terms of an information utility and information appliances plugging into that utility. We like the word utility because it conjures up in most people's minds something that's ubiquitous, like electricity or telephones. We believe that in the next three to five years, the information utility is going to become as ubiquitous as the electric utility. ... Information appliances include the desktop or laptop PC, but also a whole range of products we haven't seen yet. They'll be handheld and wireless in many cases and highly customized for a particular job. They should not necessarily be thought of as computers; they can be measurement, medical, or analytical appliances as well."
Source: Lewis Platt, Chairman of Hewlett-Packard Company, quoted by Brian Gillooly, "HP's New Course," *InformationWeek*, March 20, 1995, p. 50.
- "Intel Corp. next week will bridge the gap between the Internet and television with new technology and a who's-who list of content providers. The technology, called Intericast, allows PC users to view video over what looks like an Internet connection but is actually a separate cable or antenna analog-video link, according to sources close to the Santa Clara, Calif., company. Data and text continue to be received over the standard Internet connection."
Source: Erica Schroeder, "Intel card to add video to Internet," *PC Week Online*, October 23, 1995
- "Chip makers are on the verge of breaking down a major barrier to such multimedia advances as realistic video-game animation and high-quality video phones. ... Called media processors, the chips are expected to be six to 50 times faster than Intel Corp.'s fastest general-purpose Pentium in handling specialized multimedia calculations. The designs will allow multiple functions such as audio, video, and three-dimensional animation to be crammed on a single chip, suggesting that multimedia PCs and other devices will not only become much more powerful but also much cheaper."
Source: Don Clark, "Meet 'Media Processors,' Computer Chips for the Multimedia Age," *Wall Street Journal*, October 10, 1995, p B1.
- "Laser-enabled bandwidth in our homes will also eventually lead to a new class of entertainment devices in our homes. These will grow out of the TV/VCR/ video game player complex that exists today. In effect, we will have a "Cray on a tray" in a box sitting next to our TV monitors, delivering a host of new entertainment services. The most prosaic applications will be movies on demand and simple home shopping. The big winners and surprises will lie elsewhere, in new kinds of group activities evolving out of activities like MUDs on the Internet today. ... this entertainment will not merge with desktop PCs in the home. As a colleague, Tom Morgan, once observed, there are two screens in our houses: one that we sit 8 feet away from, and watch while leaning backwards on a couch, and a second that we sit three feet away from, and lean forward while we use it. Today, we call the former a TV, and the latter a PC. While the details of these devices will change profoundly, we will still have 8-foot and 3-foot screens in our homes decades from now."
Source: Paul Saffo, "Welcome to the Laser Decade," a presentation at Multimedia and the Boundaryless World, HBS Colloquium 95.
- "Microsoft Corp. and some high-profile partners announced plans to allow personal computers to receive satellite-television broadcasts. DirecTV said it would work with Microsoft to allow PCs to receive video programming now available to people with home TV-satellite dishes, and to receive a new category of multimedia services that the companies expect to emerge. ... Unlike cable modems, the new system will mainly deliver data in one direction - to the receiver. Eddy Hartenstein, president of DirecTV, said one possible application could be 'multimedia magazines,' such as a sports magazine that shows on a PC highlights, graphics and scores from a recent game."
Source: Don Clark and Mark Robichaux, "Microsoft Allies Plan New Uses For Home PCs," *Wall*

Street Journal, March 12, 1996, p. B5.

Rise of Network Computer

- "At some point in the near future, Compaq and other PC makers will start to produce a new kind of computer, called something like the 'Internet Surfer,' priced at about \$500, but limited in functionality to Web browsing and 'maybe to games,' predicted Bob Stearns, a Compaq VP. Compaq, 'the leading PC manufacturer,' and Intel, 'the leading chip maker,' are jointly committed to making the PC more pervasive than the TV set, added Compaq's VP of technology and corporate development."
Source: "Compaq VP Predicts \$500 'Internet Surfer' PC," Newsbyte article, October 16, 1995
- "Larry Ellison, CEO of Oracle Corporation believes that soon, personal computers will be replaced by new devices that rely almost exclusively on fast networks and have very little intelligence inside. 'Fast, cheap, networks mean computers will cost \$500, not \$5,000.' He dubbed the new devices network computers, or NCs, as opposed to today's personal computers. Network computers and similar devices, such as the interactive video set-top box, contain almost no software, just a basic input/output system, and download a complete operating system when switched on. This whole process takes only seconds to complete. ... In a world full of cheap, almost disposable, network computers, users will be able to carry a smart card to allow access to the network. Because all programs are downloaded from the network, and because everyone's personal data files and backups are stored on servers connected to the system it will be possible to slide a card into any NC and instantly begin work, as if the user were at home using their own machine."
Source: Martyn Williams, "Oracle's Vision of Networked Future," Newsbyte News Service, October 5, 1995.
- "Network computers will not replace PCs, just as PCs didn't replace mainframes. But network computers will be the center of the world. It will happen very, very fast."
Source: Larry Ellison, "New Model on Info Highway," *USA Today*, November 15, 1995, p. 2B
- "Oracle Corp. Chief Executive Officer Larry Ellison predicts the era of the personal computer is almost over and the age of the stripped-down network computer is about to dawn. Ellison is promoting the idea of an inexpensive network computer that would retail for \$500 and be used for tasks such as word-processing, electronic mail and hooking up to the Internet computer network. 'I believe that the dominance of the PC (personal computer) will prove to be a temporary transitional phase in the information age, not unlike steam power in the industrial age. I believe the era of the PC is almost over and the era of the NC (network computer) is about to begin,' he said in a speech Friday to the Commonwealth Club of California. He said the network computer would not replace the personal computer. The network computer was ideal for only a few of the thousands of applications a personal computer could be used for -- such as Internet use, electronic mail and video telephony -- 'but these tasks may account for 95 percent of all PC use,' he said. ... Ellison predicted that the price of a network computer call fall to as little as \$200 or \$300 within two years."
Source: "Oracle: Age of 'Network Computer' Dawning," Reuters article, March 10, 1996
- "The great information-appliance race is on. The goal: to create electronic gadgets that are as simple as the TV but can instantly make the connection to the digital world. At giant corporations and in garages around the globe, the brightest minds in software, hardware, industrial design, linguistics, and cognitive science are working on devices that will make it possible to move vast amounts of information and make it all as easy as punching a button on a microwave or pulling a credit card from your wallet. Armies of engineers are busy developing radically new products--from wristwatch data phones to slimmed-down personal computers for cruising the Internet. All of these intense efforts are aimed at bringing the unwired masses into the Information Age with appliances that in the 21st century will be as common as the telephone. Today's information appliance, the personal computer, has brought some 20 million people into

cyberspace--through the Internet and commercial online services. But the PC--in its present form, at least--is an unlikely vehicle to bring a mass market online."

Source: Ira Sager, "The Race is on the Simplify," Business Week Special Report: The Information Appliance, June 24, 1996

Rise of Browsable, Searchable TV

- "Scientists at Bell Laboratories are doing field trials of a new technology that automatically creates and stores text and still-frame video transcripts of television programs on the Web. ... the software is capable of distinguishing significant still images from a television and storing them in parallel with a text transcript of the TV program. The text transcript is captured from the show's closed-caption transmission and converted to HTML format, and hypertext links are added to the text transcript to make the document searchable. According to Bell Labs' Behzad Shahraray ... a one hour 'News hour with Jim Lehrer' transcription, featuring a few hundred still images and a complete hypertext transcript, you can fit the whole transcription on one floppy disk.'"

Source: Sebastian Rupley, "Browsable, Searchable TV," *PC Magazine*, February 6, 1996, p. 34
- "Most television programs, with the exception of sporting events and election results, need not be in real time, which is crucial to digital television and largely ignored. This means that most TV is really like downloading to a computer. The bits are transmitted at a rate that has no bearing on how they will be viewed. More important, once in the machine, there is no need to view them in the order that were sent. All of a sudden, TV becomes a random access medium, more like a book or newspaper, browsable and changeable, no longer dependent on time or day, or the time required for delivery."

Source: Nicholas Negroponte, *Being Digital*, Alfred Knopf, 1995, p. 49

Rise of Digital Video Disk

- "If you think the Internet has transformed the technology and entertainment landscape, wait till you see DVD -- a misleading acronym for a product that is far more than just a digital videodisk. These CDs on steroids will likely replace videotapes, audiotapes, and CD-ROMS over the next few years. 'It's clear that in a year DVD will be a big consumer phenomenon,' say Microsoft's Myhrvold. Visually indistinguishable from a CD-ROM, a DVD will hold between seven and 25 times as much data. 'Instead of a grainy, postage-stamp-size video on your PC,' Myhrvold explains, 'you'll have a full-screen image that's better looking than anything you ever saw on TV.' ... Demand for DVD likely won't soar until recordable versions hit the market; they're due by 1998. At that point, DVD may help shift the center of gravity in home entertainment even more rapidly away from the television and toward the computer. Consumers may find themselves using DVDs to capture the best content available on the Internet."

Source: David Kirkpatrick, "Riding the Real Trends in Technology," *Fortune*, February 19, 1996, p. 61

The Rise of Cheap Wireless Communications

- "Pagers have come a long way since the days when an obnoxious, beeping sound from a small black box would send you scurrying. ... Now cellular's less glamorous cousin is starting to offer even more startling products.
 - Sky Tel's new AutoLink service instantly pages an emergency response team if your airbag has been deployed. If your car gets stolen, the network alerts the cops while it tracks the car via a sensor hidden somewhere, like in an ashtray. ...
 - Skywire already uses a wireless network to do such mundane tasks as tracking the levels in propane tanks and the movement of gates at railroad crossings.
 - Skywire also has a good business monitoring vending machines for Coke."

Source: David Kirkpatrick, "Riding the Real Trends in Technology," *Fortune*, February 19, 1996, p. 62

Rise of Speech Recognition

- "If there's a technology whose time has come, it's the capability of computers to understand what we say, translate the spoken word into useful business information, and generally make it easier for us to do our jobs. Until fairly recently, speech recognition was, for all intents and purposes, dismissed as the stuff that movies were made of. ... Speech recognition is finally coming into its own. And today's demanding global business environment -- articulated so succinctly in Michael Crichton's *Disclosure* with the need for "quicker, faster, better, cheaper" -- is placing ever greater demands for making speech recognition and other human-centric technologies not only easier to use, but accessible to an international audience."

Source: Todd Watson, "Machine Talk: Speech Recognition Software Comes of Age," IBM Software Quarterly, Vol 2, No. 4, 1995

- "NetPhonic Communications Inc. today announced Web-On-Call Voice Browser software. Web-On-Call Voice Browser dramatically expands the reach of the World Wide Web, allowing instant access to information on the Web from any location, without requiring a computer or a modem. Even people who do not own a computer can access Web documents with only a touch-tone or cellular phone or a fax machine. The new software joins Internet and telephony networks to provide universal access to sites located on the World Wide Web. Using text-to-speech technology and an audio recording feature called 'Teleprompting,' Web-On-Call Voice Browser plays back Web documents over the telephone with a high degree of accuracy. It also supports documents retrieved via fax, e-mail and postal mail service. ... With Web-On-Call Voice Browser, information providers such as marketing, customer service, and other end-user departments like human resources can easily reduce database maintenance costs and keep their databases up to date. The software turns a Web document database into a 'Unified Information Store' that serves as a single repository of information to be distributed over the Internet, phone connection, wireless delivery, fax transmission or postal mail system."

Source: "Web-On-Call Voice Browser Redefines Access to the Web," Business Wire article, March 4, 1996

Rise of Talking Computers

- "Software mogul Bill Gates says computers like Hal in the movie *2001: A Space Odyssey* -- able to talk, see and listen -- could be developed by the year 2011. Faster, more powerful microchips, combined with breakthroughs in software, will allow personal computers to recognize and converse with people, Gates said today (Monday) at the annual meeting of the American Association for the Advancement of Science in Seattle. "When people look back on the computers of today, they'll say: what did they do?" says Gates, who is head of the giant Microsoft Corp. "They couldn't see, they couldn't listen, they couldn't speak."

Source: "Gates: nearing Hal, talking computers," United Press International release, February 17, 1997

Rise of Extranets

- "One good thing about the I'net world is that solutions to old problems are being recreated in a better way. All the new words created during this process are also exciting. For example, after bringing the 26-year-old computer network called the Internet into our corporations, we get intranets. Now we intelligently join these intranets to create "extranets." These amazingly promising extranet applications combine the best of both worlds."

Source: Mark Tebbe, "Extranets intelligently link intranets," PC Week, November 11, 1996

- "The universe of networked "open platform" computing is growing at a dizzying pace. First there was the public Internet, then the private Intranet and now a middle ground between the two extremes - the Extranet. The evolution of intra- from inter- to extranets might lead semanticists to

believe the terminology is simply the work of consultants eager for that next high-paying contract. But there is a distinction: Extranets represent networks that extend beyond a single company to multiple organizations that must collaborate, communicate and exchange documents in order to achieve joint goals. 'The big Net story for 1997 and beyond will be the ability to tap the power of tomorrow's Extranets,' says Troy Eid, executive director of InfoTest, a Denver-based alliance of Fortune 500 companies and governmental organizations. 'These new networks take a company's existing Intranet and extend it beyond the enterprise to enable collaborative business applications, such as electronic commerce and supply-chain management, between one company and its customers and suppliers.'

Source: Farhan Memon, "And Now, The Rise Of The Extranet," Inter@ctive Week, October 7, 1996

Rise of the Visual Computing Platform

- "In just four years, we went from "postage stamp" video to broadcast quality. And the platform will continue to evolve from the connected PC of the mid-90s to the visual computing platform on the late 90s. The focus will be on improving the PC experience at the same relentless pace the PC industry has pushed all other boundaries of new technology. By the end of the decade the definition of a personal computer will broaden again to include interactive, lifelike experiences as part of the standard platform."

Source: Andrew Grove, "A Revolution in Progress," (Comdex/Fall '96 Opening Keynote)

Rise of Personal Area Networks

- "Scientists at IBM's Almaden Research Center (San Jose, CA) are perfecting a new Personal Area Network technology (PAN) that uses the natural electrical conductivity of the human body to transmit electronic data. Using a small prototype transmitter (roughly the size of a deck of cards) embedded with a microchip, and a slightly larger receiving device, the researchers can transmit a pre-programmed electronic business card between two people via a simple handshake. What's more, the prototype allows data to be transmitted from sender to receiver through up to four touching bodies."

Source: "Hi Tech, hi touch: Personal Area Networks," IBM Research

Rise of Quantum Computers

- "Computer scientists say they are moving closer to development of supercomputers using the laws that govern subatomic particles to operate instead of transistors and silicon chips. They say such machines -- called quantum computers -- will reshape how businesses, schools, governments, and individuals communicate. Robert Calderbank of AT&T Laboratories in Murray Hill, N.J., told scientists in Seattle for the annual meeting of the American Association for the Advancement of Science that 'I believe in the next 20 years, quantum computing is going to have the same effect on us as the railroad did in the 19th century.' Calderbank says that the United States that was transformed from agricultural to industrial more than a century ago will become part of a global society based on electronic commerce."

Source: "Supercomputers to transform society," United Press International release, February 18, 1997

Rise of the Conversational Computer

- "Software mogul Bill Gates says computers like Hal in the movie 2001: A Space Odyssey -- about to talk, see and listen -- will be in homes by the year 2011. ... 'When people look back on the computers of today, they'll say: what did they do?' says Gates. They couldn't see, they couldn't listen, they couldn't speak."

Source: "Gates: Talking Home Computers by 2011," UPI article, Feb. 17, 1997

Rise of IP Everywhere

- “we are on the verge of a global area network with billions of users. Our cars, appliances, pagers, and homes will transmit information from their own Internet addresses. 'Your car is going to send you an email message telling you it is time for an oil change.'”

Source: John Patrick (vice president of Internet technology at IBM), quoted by Patrick McKenna, “Internet World - IBM's John Patrick Delivers Internet Vision,” Newsbytes News Network article, March 14, 1997

Rise of Wireless Networks

- “In the next decade, some 1,700 satellites will be launched in space, creating the potential for more than 3 billion people to view CNN, make a phone call, tap into the information highway, or watch reruns of Seinfeld and the X-Files. Assimilation will be swift. Our modern communications system is the result of more than a half a century of planting copper wires in the ground, over our heads, and in our walls. The twenty-first century's infrastructure of satellites, ground stations, and wireless networks is being put in place in a fraction of that time.”

Source: Regis McKenna, *Real Time*, Harvard Business School Press, 1997, p. 27

Rise of Power Line Telephony

- “Engineers claim to have developed a breakthrough technology that would let homeowners make phone calls and access the Internet at high speeds via the electric outlets in their walls. If the technology developed by United Utilities PLC and Northern Telecom Ltd. proves commercially viable, it could transform power lines around the world into major conduits on the information superhighway.”


Source: Gautam Naik, “Electric Outlets Could be Link to the Internet,” *Wall Street Journal*, October 7, 1997, p. B6.

Rise of Virtual Supercomputer Networks

- “Data networks will also deliver new clout to the desktop--clout some think can change the balance of power in industries. Under a contract from the National Science Foundation, MCI is building Internet 2--a next-generation, very-high-speed data network. Today it links five supercomputing centers in the U.S., enabling them to pool processing power for work on complex problems like drug design and weather forecasting. Within two years, 100 universities will be able to tap into the system. In four to five years, anyone will. Says MCI chief engineering officer Fred Briggs: 'Imagine you're at your desk. Your PC is the equivalent of a mainframe, you have unlimited bandwidth and can time-share into a virtual supercomputer network. What kind of capabilities will that bring to thousands of entrepreneurs around the world?'”

Source: Andrew Kupfer, “Transforming Telecom: The Big Switch,” *Fortune*, October 13, 1997, pp. 105-116.

Demise of the Internet Backbone Problem

-  “As recently as two years ago, all the phone systems in the world operated at the rate of one terabit per second. Early last year, NTT, Lucent, and Fujitsu demonstrated one perabit per second down a single fiber-optic thread. This year, NEC demonstrated three terabits per second. One fiber thread can accommodate more information than the global telephone network three years ago. The explosive developments in fiber over the next four or five years are going to overcome most of the backbone problems that affect the Internet.”

Source: George Gilder, “Newsmaker Q&A,” *Internet World*, December 1997, p. 30

Rise of Data Broadcasting

- "You thought the Internet was a revolution? Just wait. Over the next year or so, a new means of information distribution called data broadcasting will simultaneously upset the market for Internet content, topple the current standards in the consumer-electronics industry, save the hard-drive industry from its worst slump in years, and qualify the federal government's HDTV bandwidth grant as the greatest charity event in the history of the world. So what is data broadcasting? Just what it sounds like: a system that sends huge amounts of data to a huge number of people simultaneously. This information could be anything that might appeal to multiple users--stock market prices, say, or sports scores. ... How will data broadcast work? We will first need technology in our homes to connect either the PC or a television set-top box to a broadcast network. For cable or satellite networks, the connection will be via coaxial cable. But the first wave of data broadcast will likely use excess capacity in VHF channels, so we may witness the irony of bunny ears attached to our PCs. Once we're hooked up, data broadcasters will broadcast to our homes continuously. Our devices will be programmed to capture the data that we might want. ... Every minute, about 175 DirecTV channels soar past your head. Just one of those channels could handle 32 megabits of data each second."

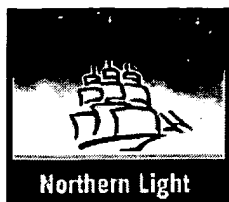
Source: J. William Gurley, "Why Data Broadcast May Take Over the World," *Fortune*, January 12, 1998

Rise of Telematics

- "It's not in the dictionary yet but Motorola says "telematics" is going to be a multi-billion dollar business and it has set up a special division to tap the potential of hard-wiring cars for global positioning systems linked to cellphones. What is telematics? Motorola says it is "a new way of using wireless voice and data to provide drivers and their passengers with location-specific security, information, convenience and entertainment services from a central service center."

Source: "What is telematics? Big business, says Motorola," Reuters article, February 4, 1998

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DS- <REGIONAL> AT; BE; CH; DE; DK; EA; ES; FI; FR; GB; GR; IE; IT; KE; LS;
LU; MC; MW; NL; OA; PT; SD; SE; SZ; UG|

AB- <BASIC> WO 9712456 A

The data communications network includes a local area network (LAN) (32), and a wireless local loop (WLL) (34) coupled to the LAN. A packet switched network (36) is coupled to the wireless local loop. This loop conforms to a transmission control protocol internet control transmission and addressing protocol (TCP/IP).

The packet network conforms to a TCP/IP transmission and addressing protocol, or to a UDP transmission and addressing protocol. The wireless local loop conforms to an ethernet protocol, and is a wireless T1/E1 channel with a coder decoder connected to it.

ADVANTAGE - Provides low cost and flexible system for connecting widely separated local area network or individual computers.

Dwg.2/8|

DE- <TITLE TERMS> DATA; COMMUNICATE; NETWORK; COMPUTER; COMMUNICATE;
OPERATE; SYSTEM; LOCAL; AREA; NETWORK; COUPLE; WIRELESS; LOCAL; LOOP;
PACKET; SWITCH; NETWORK; COUPLE; LOOP; LOOP; CONFORM; TRANSMISSION;
CONTROL; PROTOCOL; CONTROL; TRANSMISSION; ADDRESS; PROTOCOL|

DC- T01; W01|

IC- <MAIN> H04J-003/02|

MC- <EPI> T01-H07C5E; W01-A03B; W01-A06B5A; W01-A06B5B; W01-A06B7;
W01-A06G3|

FS- EPI||

?

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S2	0	AU="BOWMAN AMUAH M"

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File 148:GALE GROUP TRADE & INDUSTRY DB 1976-1999/JAN 05
(c) 1999 THE GALE GROUP
File 553:Wilson Bus. Abs. FullText 1982-1999/Sep
(c) 1999 The HW Wilson Co

Set	Items	Description
S1	0	AU="BOWMAN-AMUAH, M"
S2	1	AU="BOWMAN, M. K"
S3	0	CS="INTERTRADE COMPUTER"
S4	1	CO="INTERTRADE CO LTD":CO="INTERTRADE COMPUTER"
S5	0	INTERTRADE()COMPUTER()CONSULTANT?
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?show files;ds

File 278:Microcomputer Software Guide 1999/Dec

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S1	0	AU="BOWMAN-AMUAH, M"
S2	0	CO="INTERTRADE COMPUTER CONSULTANTS"

1/9/1

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08664831

INTERTRADE COMPUTER CONSULTANTS LIMITED

C/O W ALBAN & CO

12 BRIDGE STUDIOS

318 WANDSWORTH BRIDGE ROAD

LONDON SW6 2TZ

COUNTRY: ENGLAND & WALES

ACCOUNTING REFERENCE DATE:	March 31
DATE OF INCORPORATION:	September 4, 1989
DATE DISSOLVED:	May 16, 1995

ISSUED CAPITAL (STERLING): NA

NUMBER OF EMPLOYEES: NA

REGISTERED COMPANY NUMBER: 02419588

ACCOUNT TYPE: NA

COMPANY TYPE: Private limited with share capital

This is a DISSOLVED company

LATEST 10 TRANSACTIONS

May 9, 1995:	Final dissolution
January 31, 1995:	Orders for dissolution of winding up
December 13, 1990:	Appointment of liquidator
December 12, 1990:	Copies of winding up orders
November 7, 1990:	Appointment of liquidator

1/3/1

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06554377

INTERTRADE COMPUTER CONSULTANTS

1115 ELKTON DR # 300
COLORADO SPGS, CO 80907-3535

Current as of: 09-06-99

Telephone: 719-599-3670
Experian Company Number: R03073177

KEY FACTS

SIC

Code Description

7371 - CUSTOM COMPUTER PROGRAMMING SVCS

1/3/2

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03929558

INTERTRADE COMPUTER CONSULTANTS

PO BOX 213
FRANKLIN PARK, NJ 08823-0213

Current as of: 09-06-99

Experian Company Number: J01063037

1/3/3

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03925438

INTERTRADE COMPUTER CONSULTANTS

7 PETUNIA DR
N BRUNSWICK, NJ 08902-3720

Current as of: 09-06-99

Experian Company Number: J00786511

KEY FACTS

SIC

Code Description

7389 - BUSINESS SERVICES,

Customers:

Square feet:

Officers:

- HJAZEH, WAJIH

1/3,AB/1

DIALOG(R)File 351:DERWENT WPI

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011235330

WPI Acc No: 97-213233/199719

XRPX Acc No: N97-175848

Data communications network for computer communications with different operating system - has local area network with coupled wireless local loop, and packet switched network coupled to loop, where loop conforms to transmission control protocol internet control transmission and addressing protocol

Patent Assignee: INTERTRADE COMPUTER CONSULTANTS INC (INTE-N

Inventor: BOWMAN-AMUAH M

Number of Countries: 070 Number of Patents: 002

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Main IPC	Week
WO 9712456	A1	19970403	WO 96US15598	A	19960924	H04J-003/02	199719 B
AU 9673794	A	19970417	AU 9673794	A	19960924	H04J-003/02	199732

Priority Applications (No Type Date): US 95533709 A 19950926

Language, Pages: WO 9712456 (E, 19)

Abstract (Basic): WO 9712456 A

The data communications network includes a local area network (LAN) (32), and a wireless local loop (WLL) (34) coupled to the LAN. A packet switched network (36) is coupled to the wireless local loop. This loop conforms to a transmission control protocol internet control transmission and addressing protocol (TCP/IP).

The packet network conforms to a TCP/IP transmission and addressing protocol, or to a UDP transmission and addressing protocol. The wireless local loop conforms to an ethernet protocol, and is a wireless T1/E1 channel with a coder decoder connected to it.

ADVANTAGE - Provides low cost and flexible system for connecting widely separated local area network or individual computers.

Dwg.2/8

***** Computer Select, December 1995 : Articles *****

Journal: Government Computer News Oct 30, 1995 v14 n23 p39(2)
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Title: Don't slip softly into the swamp; Navy and Air Force guides
help software managers avoid common traps.
(Government Activity)

Author: Constance, Paul

Abstract: Studies show that most managers of major development projects have never managed a large software purchase or received the necessary training for handling the project. The Department of Defense's (DOD) Software Acquisition Best Practices Initiative has released booklets and videos to help these beginning software managers. A 15-page booklet, the Little Yellow Book of Software Management Questions, distills the advice of 200 senior managers into nine principles. Another booklet, Project Breathalyzer, identifies software projects that should not be continued. The Program Manager's Guide to Software Acquisition Best Practices is a 140-page book that contains the nine principles and 43 more good practices. It also offers a project control panel for quantifying such factors as staff turnover, overtime hours, cost performance indices and defects.

Full Text:

Here's the scenario: You're an ambitious program manager who knows the difference between RAM and ROM. And you've just been made manager of a \$50 million software development acquisition that will try to consolidate 2 million lines of legacy code into a single Ada system.

Chances are, you've just walked into a steaming management swamp.

Research conducted by the Software Engineering Institute in Pittsburgh found:

- * More than a third of all large-scale software development projects are canceled.
- * The average project runs 50 percent over its schedule.
- * Three quarters of all large-scale applications are "operational failures" that don't function as intended.

Defense Department studies show that most program managers of its major development projects have never managed a large software buy or received special training to do so.

Vaguely aware of these perils, your boss is eager to hear a detailed explanation of your acquisition strategy. What do you do?

For starters, you might try the equivalent of the software manager's Cliffs Notes. Last month, DOD's Software Acquisition Best Practices Initiative, managed by the Navy's Software Program Managers Network (SPMN), released a set of videos and pocket-sized booklets aimed at neophyte software managers.

In a mere 15 pages, the Little Yellow Book of Software Management Questions, distills into nine principal practices the accumulated wisdom of 200 senior managers (See box).

Mindful that the information superhighway is littered with software development wrecks, the SPMN also offers a Project Breathalyzer booklet "to identify software projects that should not be on the road."

To determine if your project is among these, the book includes nine questions to help managers stay on track. It asks, for example: Can you list the current top 10 project risks? Do you know the percentage of external interfaces not under your control?

Best practices

The SPMN also has released The Program Manager's Guide to Software Acquisition Best Practices, a 140-page elaboration of the nine principal practices and 43 other best practices. The book also includes what it calls a project control panel to help managers quantify factors such as staff turnover, overtime hours, defects and cost performance indices.

The SPMN knows these tools alone won't make or break "These practices are termed 'best practices' not because they have been intensively studied and analytically proven to be the best, but simply because they are practices used by, and considered critical to, successful software projects," noted Norm Brown, SPMN coordinator, in the introduction to the book.

Brown described the recommendations as a "living set" that should be refined over time. He asked that users send their suggestions via the Internet to best@spmn.com.

The SPMN videos include Managing Complexity Before It Explodes Your Project, and Eliminating Excess Software Documentation.

For a more detailed map to success, get the Air Force's Guidelines for Successful Acquisition and Management of Software Intensive Systems, Version 1.1. Released in February, the manual would more aptly be called a layman's concise encyclopedia of software development concepts, management and DOD policy.

In clear prose, the Air Force's guide answers most imaginable questions of the first-time software manager. It also includes excellent summaries of relevant DOD directives and standards, and chapters on system development and engineering, Ada, strategic planning, contracting and process improvement.

Beyond the checklist

"We've tried to go beyond the checklist concept and show people how to actually do things," said Lloyd Mosemann III, deputy assistant secretary of the Air Force for communications, computers and support systems. "At the same time, we were really trying to reach program managers who are not information system specialists and to produce something people would actually read."

Mosemann said the Air Force has distributed more than 6,000 copies of the guidelines and soon will complete Version 2.0, which will include

examples from Army and Navy projects and chapters on risk management, software development maturity, metrics, reuse and software support.

Paul A. Strassmann, DOD's former chief information officer and a reviewer of both Air Force and Navy guidelines, warns they won't necessarily show managers how to institute a software development process that ranks high on SEI's capability maturity model.

"As educational efforts, both publications are exemplary," Strassmann said. "As implementation tools, they are not sufficient."

Call 703-521-5231 for the SPMN materials and 801-777-8045 for the Air Force guidelines.

RELATED ARTICLE: Nine of the best practices

- * Set up a formal risk management process.
- * Agree on a baseline user interface early in the project.
- * Hold peer reviews of all aspects of the project throughout development.
- * Establish metric performance measurements to track project status.
- * Require regular progress evaluations, letting the project move to the next phase only if it meets predetermined criteria.
- * Ensure that all participants receive all project updates, the bad news as well as the good.
- * Create a formal program to track defects at each project phase.
- * Institute a configuration management process to identify, document, control and approve changes made during the project's lifecycle.
- * Ensure that management is accountable for providing qualified staff and fostering a good working environment with low turnover.

Topic: United States. Department of Defense
Programming Project Management
Government Activity
Book

Record#: 17 576 606

*** End ***

8/3,AB/12 (Item 9 from file: 148)
DIALOG(R)File 148:Gale Group Trade & Industry DB
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08047553 SUPPLIER NUMBER: 17126787 (USE FORMAT 7 OR 9 FOR FULL TEXT)
IEEE NAMES RAYTHEON AS LEADER IN SOFTWARE INDUSTRY
PR Newswire, p801NE017
August 1, 1995
LANGUAGE: English RECORD TYPE: Fulltext
WORD COUNT: 495 LINE COUNT: 00054

8/3,AB/13 (Item 10 from file: 148)
DIALOG(R)File 148:Gale Group Trade & Industry DB
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07945098 SUPPLIER NUMBER: 17083274 (USE FORMAT 7 OR 9 FOR FULL TEXT)
Model improvement. (Carnegie Mellon's Capability Maturity Model)(PC
Week Executive)
Callaway, Erin
PC Week, v12, n24, pE7(1)
June 19, 1995
ISSN: 0740-1604 LANGUAGE: ENGLISH RECORD TYPE: FULLTEXT; ABSTRACT
WORD COUNT: 687 LINE COUNT: 00057

ABSTRACT: The process of rolling out new products has changed over the years as projects are currently developed closely with users and unveiled in stages to maximize their business impact. For example, a GUI developed by Carnegie Mellon University's Software Engineering Institute for the Dept of Defense is being used by customer-service employees to improve the development process. The new order-fulfillment system, known as the Capability Maturity Model (CMM), is not scheduled to hit the market until 1997, but it is currently being used to evaluate the development process. Vendors using the system, such as Texas Instruments, claim drastic reductions in product defects. Implementing CMM has resulted in some companies saving four to eight times what they would typically invest to make process improvements.

8/3,AB/14 (Item 11 from file: 148)
DIALOG(R)File 148:Gale Group Trade & Industry DB
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07834542 SUPPLIER NUMBER: 16866468 (USE FORMAT 7 OR 9 FOR FULL TEXT)
Base is tops in info systems. (McClellan Air Force Base)
McCarthy, Shawn P.
Government Computer News, v14, n7, p38(1)
April 3, 1995
ISSN: 0738-4300 LANGUAGE: ENGLISH RECORD TYPE: FULLTEXT; ABSTRACT
WORD COUNT: 686 LINE COUNT: 00074

ABSTRACT: The McClellan Air Force Base achieves Level 3 in the five-level Capability Maturity Model of the Software Engineering Institute in Oct 1994, one the few organizations to attain it. The base's software engineers

Journal: Government Computer News April 3, 1995 v14 n7 p38(1)
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Title: Base is tops in info systems.
(McClellan Air Force Base)
Author: McCarthy, Shawn P.

Abstract: The McClellan Air Force Base achieves Level 3 in the five-level Capability Maturity Model of the Software Engineering Institute in Oct 1994, one the few organizations to attain it. The base's software engineers have created the Process/Project Management Tool Set which comprises off-the-shelf integrated project management software. McClellan's operations focus on operational flight programs, the global maintenance of A-10 and F-111 fighter jet weapons systems, and command and control programs for airborne, orbiting and ground station platforms. Its software engineers use a combination of DEC VAX minicomputers, Unix systems, mainframes and DOS and Windows PCs. Many of its systems are 20 to 30 years old. The base's software developers are housed in 16 buildings and are connected by a LAN running Oracle DBMS.

Full Text:

McClellan Air Force Base, Calif., is a government leader in developing, maintaining and re-engineering large-scale information systems.

Last October, the base's software development facility attained Level 3 in the Software Engineering Institute's five-level Capability Maturity Model, which rates how well a facility manages software projects. Only about 9 percent of all private- and public-sector facilities have ever reached Level 3.

To control their software activities, McClellan engineers have integrated commercial-off-the-shelf project management applications into what they call the Process/Project Management Tool Set.

Bill Wilkinson, McClellan software process engineer, said developers there deal with everything from mainframes to embedded systems, with a heavy concentration on client-server applications.

Flight and fighters

The base is known for its operational flight programs, worldwide maintenance of F-111 and A-10 fighter jet weapons systems, and command and control for orbiting, airborne and ground station platforms. Future responsibilities could include software for the F-22 advanced tactical fighter.

Developers work at an eclectic collection of Digital Equipment Corp. VAX minicomputers, Unix systems, old and new mainframes, and MS-DOS and Microsoft Windows PCs.

"We have to support what's already out in the field," Wilkinson said, "so we try to obtain, duplicate and repair the same equipment here." Some of the Air Logistics Center systems are 20 to 30 years old.

Update cycles for fighter system software are a year and a half; others range from an-scheduled to two years. Difficulty coordinating schedules prompted the customized management tool set.

"In the late 1980s, we developed something called the Post-Deployment Software Support Process," Wilkinson said. "It was a 700-page book of data flow diagrams and descriptions of how to do block changes from start to finish. It listed details from the time we started evaluating the changes until we produced a modification package."

That system, though rigorous, was paper-based. Managers wanted to automate it, but no single package gave them all the functions needed. Different offices were using Scitor Corp.'s Project Scheduler 5, Microsoft Corp. Project, management tools from Timeline Inc. and Artemis Prestige from Lucas Management Systems, Redwood City, Calif.

Managers also wanted to harness development with project management to trace resources, tasks and processes through the organization, not just within projects.

"In our defined process, we identify who, what, when, where, why and how," Wilkinson said. There are inputs, outputs, configuration management and more. No project management tool could do all that on its own."

Wilkinson said Prestige became the core of the composite system because it had multi-project capability when the project began. It also had an open architecture and built-in interface for Oracle Corp. databases. A new database now permits dozens of engineers and managers to share data from any defined software update process. Anyone can read the documentation and see the steps taken.

That's a big cultural change from the way software was developed. "Programmers like to be thrown in a room, given a Twinkie and a couple of Cokes and told, 'Code this.' We'd say, 'See me tomorrow morning and I'll have it for you.' But we don't like to record steps."

Need to be competitive

However, engineers also understand the need to be competitive, he said. "If the resident expert gets hit by a truck, we won't end up being dead too, if we know which steps produce which output."

Development staff work in 16 buildings at McClellan, connected by a large local area network. Their shared Oracle database resides on a Digital Equipment Corp. Alpha AXP 3000 system running OSF/L. It serves 400 people, most working at 486 and Pentium PCs. They log in via TCP/IP and forms created in Powersoft Corp.'s PowerBuilder.

Wilkinson said the form's approach insulates project managers from Oracle interfaces like SQLNet. "They just need to access data," he said. "This lets them do it right from their Windows environment." Engineers can access reports that list tasks, dates and deliverables.

The Prestige tool set recently has evolved into Artemis Views, a set of client-server tools for multi-application management, with a direct interface to Microsoft Project.

Topic: United States. Air Force

Government Activity
System Design

Record#: 16 866 468

*** End ***

Journal: PC Week June 19, 1995 v12 n24 pE7(1)
COPYRIGHT Ziff-Davis Publishing Company 1995

Title: Model improvement.
(Carnegie Mellon's Capability Maturity Model) (PC Week
Executive)
Author: Callaway, Erin

Abstract: The process of rolling out new products has changed over the years as projects are currently developed closely with users and unveiled in stages to maximize their business impact. For example, a GUI developed by Carnegie Mellon University's Software Engineering Institute for the Dept of Defense is being used by customer-service employees to improve the development process. The new order-fulfillment system, known as the Capability Maturity Model (CMM), is not scheduled to hit the market until 1997, but it is currently being used to evaluate the development process. Vendors using the system, such as Texas Instruments, claim drastic reductions in product defects. Implementing CMM has resulted in some companies saving four to eight times what they would typically invest to make process improvements.

Full Text:

With a possible boost from ISO9000 standards, Carnegie Mellon's CMM is helping civilian companies march to the beat of effective software development.

Rolling out new systems at Texas Instruments Inc. used to be more like the big bang than a planned process. A business unit would make a request, IT would disappear into development, and after some time, bang--a new system was born.

Today, those grand-slam creations are a thing of the past. Projects are developed closely with users and rolled out incrementally so they can have an immediate business impact. One example: the GUI of a new order-fulfillment system not slated to switch on until 1997 is already being used by customer-service workers to enter orders.

What brought on the dramatic changes? The Capability Maturity Model (CMM) developed by Carnegie Mellon University's Software Engineering Institute for the Department of Defense (DoD). Using it to evaluate--and revamp--its software-development processes, TI has greatly scaled back on defects appearing in final products. It has also slashed the cycle time of projects from 24 months to 18 months, and changes to how TI procures funding will shave off an additional nine months by 1996, says Jimmy Jobe, software engineering process group manager for TI's Information Systems & Services group in Dallas. While Jobe has yet to place a dollar value on the changes, the quality of IS&S's systems are five times what they were four years ago.

TI isn't the only civilian company riding the CMM wave. Many are applying the five official CMM maturity levels (see chart, XX) to cost-justify outsourcing development projects or to furnish intelligence about an IT organization during a merger or acquisition. Others are making the CMM a

stringent part of doing business. Boeing, for example, now requires suppliers to implement the CMM or a similar model. If suppliers fail to meet that requirement, they may be declined for contracts, according to sources at the SEI. Boeing officials in Seattle could not be reached for comment.

In the midst of this groundswell of support, the SEI is working to improve the CMM. One proposal is to augment CMM Version 2.0 with more human factors by incorporating ISO 9000 software standards on installation, delivery, and customer support. "The changes would harmonize the CMM with ISO," says Mark Paulk, senior member of SEI's technical staff in Pittsburgh. If the SEI votes to include the ISO elements, companies using the CMM will meet many of the requirements needed for an ISO certificate.

Making the CMM a benchmark for the softer side of software development is critical with companies spending between \$500 to \$2,000 per software engineer annually to make the improvements necessary to move up the CMM ladder, says Capers Jones, chairman of Software Productivity Research Inc., a consultancy in Burlington, Mass, citing such factors as physical environment, hiring practices, and compensation levels.

Yet even without these elements, return on investment in the CMM can be anywhere from four to eight times what companies invest to make improvements in their processes, claims Paulk. He also points out that the original model was designed to measure software, not people. "Would you trust engineers to evaluate that?" he jokes.

How the Capability Maturity Model Stacks Up

Level 1: Chaos. Your software-development process is, at best, ad hoc. If you complete a project once, there's little chance you'll be able to duplicate it.

Level 2: Double trouble. You have the basic processes in place to repeat earlier successes, but your cost and schedule tracking skills leave a lot to be desired.

Level 3: Three times a charm. Your processes are documented, standardized and integrated into every product.

Level 4: Expert. You quantitatively understand and control your development process and your products.

Level 5: Development Nirvana. You have refined the process of gathering quantitative feedback, enabling you to embark on continuous, controlled process improvement.

Topic: Customer service
 Order Entry Software
 GUI
 Carnegie-Mellon University. Software Engineering Institute

Record#: 17 083 274

*** End ***

Government Computer News, v14, n18, p53(2)

August 28, 1995

ISSN: 0738-4300 LANGUAGE: English RECORD TYPE: Fulltext; Abstract

WORD COUNT: 1105 LINE COUNT: 00092

ABSTRACT: The Department of Defense (DOD) sets up 19 pilot projects to test the effectiveness of the Logicon Software Engineering Environment, developed by Logicon Inc under the agency's Integrated-CASE (I-CASE) contract. The results of the pilots will be evaluated in summer 1996 to determine if I-CASE will become a departmentwide software development standard. I-CASE products require users to be proficient in Unix and to have an established software development process. Logicon integrates some 50 application development tools into three categories, Upper CASE, Horizontal CASE and Lower CASE. Logicon has created a common repository so developers can use various tools on the same data using data bridges. While Logicon's advantages are obvious, DOD officials point out that it cannot resolve a failing development effort.

8/3,AB/8 (Item 5 from file: 148)

DIALOG(R)File 148:Gale Group Trade & Industry DB

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Don't slip softly into the swamp; Navy and Air Force guides help software managers avoid common traps. (Government Activity)

Constance, Paul

Government Computer News, v14, n23, p39(2)

Oct 30, 1995

ISSN: 0738-4300 LANGUAGE: English RECORD TYPE: Fulltext; Abstract

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ABSTRACT: Studies show that most managers of major development projects have never managed a large software purchase or received the necessary training for handling the project. The Department of Defense's (DOD) Software Acquisition Best Practices Initiative has released booklets and videos to help these beginning software managers. A 15-page booklet, the Little Yellow Book of Software Management Questions, distills the advice of 200 senior managers into nine principles. Another booklet, Project Breathalyzer, identifies software projects that should not be continued. The Program Manager's Guide to Software Acquisition Best Practices is a 140-page book that contains the nine principles and 43 more good practices. It also offers a project control panel for quantifying such factors as staff turnover, overtime hours, cost performance indices and defects.

8/3,AB/9 (Item 6 from file: 148)

DIALOG(R)File 148:Gale Group Trade & Industry DB

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Robbins-Gioia signs agreement with Software Engineering Institute to help ensure software development excellence; Robbins-Gioia to deliver industry standard project management workshop for software development professionals.

Business Wire, p9121153